0 TSG-RAN Working Group 1 meeting #2 ***TSGR1#2(99)071***
1 Yokohama, Japan
2 February 22-25, 1999

Agenda Item: 5

Source: Ericsson, Nokia

Title: Proposal for 3GPP baseband key characteristics ~~(DRAFT)~~

Document for:

---

1 Introduction

This document provides an initial 3GPP list of base-band characteristics. The intention is to be able to determine the 3GPP UTRA values for the base-band key characteristics list that is being developed by ITU-R TG8/1 in the draft recommendation IMT.RKEY, which is to be finalised in March. It is suggested that the parameters in this list are discussed and updated accordingly in order to have a list agreed by all 3GPP partners. That agreed list should be submitted to the next TG8/1 meeting held in Fortaleza (Brazil) on ~~in the beginning of~~ March 8-19.

TABLE 2

Baseband Key Characteristics

#	Names of the Key Characteristics	Definitions	Values
1	**Multiple access technique**	The multiple access technique allows multiple users to share transmission media without creating uncontrollable interference to each other. The multiple access techniques can be used individually or in a hybrid mode, for example, time, code and space multiplexing (TD/CD/SDMA). Note: Different multiple access schemes usually employ different radio techniques. For example, CDMA commonly uses fast power control; and TD/CDMA typically uses joint detection. Similarly, SDMA generally employs adaptive beamforming.	FDD: DS-CDMA TDD: DS-CDMA/TDMA
2	**Chip rate**	The rate at which information data is spread by pseudo random code modulation elements in a direct sequence CDMA system. Notes: The transmitted signal bandwidth is a function of the chip rate. It has key impact on multipath signal delay resolution capability and the processing gain of DS-CDMA systems.	~~1.024,~~ 4.096, 8.192, 16.384 Mcps
3	**Frame structure**	Frame Structure is a specified portion of time slots. Frame structure has two important aspects, one of which is number of time slots in a frame and another one is frame length. • Number of time slots in a frame • Frame Length Note: The frame structure is a key characteristic of baseband system, since it may be affected by parameters such as multiple access scheme, duplexing scheme, power control, interleaver size and vocoder scheme.	Number of time slots in a frame: 16 Note: In FDD, a user normally transmi~~t~~ts/receives on all 16 time slots. Frame length: 10 ms
4	**Variable length spreading factor**	A modification of a direct sequence spreading code that creates a family of orthogonal codes of variable length to support variable data rates in a DS-CDMA system. Notes: The use of orthogonal variable spreading codes enables	FDD: 4-256 TDD: 1-16

		implementation of data rates greater than 8-16 kbps with minimal complexity & performance impact.	
5	**Inter base station asynchronous/ synchronous operation**	System base stations whose relative time difference is determined and maintained to a very tight tolerance e.g., a chip period, by utilization of a common clock or timing source, are said to be synchronized. Asynchronous base stations may use a common timing source mainly for frequency stability purposes, but there is no requirement on the relative time difference between them. Notes: Synchronous systems are desirable for 2G/3G roaming within the same frequency band for existing 2G synchronized systems. Asynchronous systems facilitate multi-environment user roaming without accurate base station synchronization.	FDD: asynchronous or synchronous TDD: synchronous (frame level)
6	**Inter-user synchronization**	A method used to synchronize all DS-CDMA user transmissions in a sector or cell at the base station receiver. Notes: This can simplify many advanced DSP implementation requirements such as joint detection, beam-forming and software radio design. It can also decrease fast power control requirements and inter users interference with orthogonal codes. Inter-user synchronization is used only for CDMA.	~~FDD: used in DL, option in UL~~ ~~TDD: used in DL and UL~~Optional uplink synchronization
7	**Handover**	In general, handover is the process of transferring the mobile station's communication from one radio channel to another when the mobile is moving between sectors or between cells. Note: Handover is an essential element of a mobile telecommunications system as it permits mobility through the coverage area of the network. There are two types of handover - hard and soft, depending upon whether there are simultaneous connections to more than one base station during the handover process. . Soft handover has the benefit of allowing diversity combining of signals to enhance performance. Of particular importance when defining the handover mechanism are • the measurement method that triggers the handover, • whether the mobile station assists in the handover process by performing measurements, or initiates the handover, and the messaging between the mobile station and base station during the course of the handover.	~~• Hard handover~~ ~~• Soft/softer handover~~ ~~• Inter- and intra-system handover (including between 2G and 3G)~~ ~~• Inter-frequency handover~~ The following types of handover are supported: - Intra-system/intra-frequency handover: - Soft/softer handover - Hard handover - Intra-system/inter-frequency handover: - Hard handover - Inter-system handover: - Hard handover

8	**Channel coding and interleaving**	**Channel coding and decoding** is the process to introduce some redundancy in the information sequence in a controlled manner such that the redundancy can be used at the receiver to overcome the effects of noise and interference encountered in the transmission channel, thus increasing the reliability of the received data. Note: Channel coding techniques (e.g., convolutional codes, block codes, turbo codes) are essential in achieving low bit error ratios and/or coding gain. Turbo codes have recently been shown to improve system capacity and QoS for high data rate services. The components of a Turbo coder consist of recursive systematic coders and an interlever. The improvements resulting from Turbo codes are dependent on the design (generator polynomial) of the recursive systematic coders and interleaver matrix. **Interleaving and de-interleaving** is the process to permute the transmission sequences of coded bit stream prior to modulation and to reverse this operation following demodulation. It is used to separate and redistribute bursty errors over several codewords or constraint lengths for higher probability of correct decoding by codes designed to correct random errors. Note: Interleaving helps in randomizing error patters. The effectiveness of interleavers generally improves with size, representing a design trade-off with signal delay. The interleaver depth, to be effective, must be large compared with the mean duration of channel fades.	**Coding:** Convolutional code with K=9, R=1/2, or 1/3 Turbo code with K=4 or K=3 **Interleaving:** Inter-frame interleaving (20/40/80 ms) Intra-frame interleaving (10 ms)
9	**Random access**	Random Access is the technique for multiple mobile stations to access radio channels without prior scheduling. Note: Because of the lack of pre-arrangement, collisions of the transmissions from different stations occur, at an average rate that depends on the traffic and re-transmission rules. An optimized random access design minimizes collisions among mobile stations, thereby throughput and reducing delay and interference.	FDD: Slotted ALOHA with power ramping on preamble (1 ms) followed by message (10 ms) TDD: <*To be filled in*>defined
10	**Modulation (up-link and down-link)**	The process of varying certain parameters of a digital code signal (carrier), through digital signal processing, in accordance with a digital message signal, to allow transmission of the message signal through IF and RF channels, followed by its possible detection. Notes: Modulation is important because variation of the code signal	FDD: Data modulation: UL BPSK, DL QPSK Spreading modulation: UL dual-channel QPSK, DL QPSK TDD:

		parameters can impact QoS or lead to significant variations in system complexity.	Data modulation: QPSK??? Spreading modulation: QPSK???
11	**Channelization code (up-link and down-link)**	Channelization codes are set of orthogonal codes used for spreading and identification of any other channels. Note: It is important in CDMA systems to minimize the interference between users and between channels in the cell in down-link and between channels of a user in up-link	Real OVSF (Orthogonal Variable Spreading Factor) codes
12	**Scrambling code (up-link and down-link)**	Scrambling code is used in DS-CDMA systems to identify BTS or sector in down-link, and MS in up- link. Note: It is important for multiple access system to correctly identify users.	FDD: DL: Complex code, 40960 chips (10 ms) segments from Gold codes. UL: Complex code, 40960 chips (10 ms) segments from Gold codes (long codes), or 256 chips extended S(2) codes (short codes). HPSK transformation applied on the codes. TDD: <*To be filled in*>, 1 16 chips
13	**Pilot structure**	The system pilot is used for channel searching, estimation, acquisition, demodulation and can also be used to assist soft handover. It can also be used to implement fast power control and adaptive antenna technologies. The pilot can be continuous and code multiplexed, or periodic and time multiplexed. Notes: A pilot channel or pilot symbols provide a phase reference for coherent detection. It also provides a means for signal strength comparison between the base stations. This makes soft handover possible. The downlink pilot can either be common to all users in a cell or a sector, or dedicated to each traffic channel. The pilot channel structure can impact overall system capacity and performance.	FDD: Time-multiplexed dedicated pilot symbols, and time-multiplexed common pilot symbols on common control physical channel TDD: Time-multiplex dedicated pilot sequence
14	**Detection (up-link and down-link)**	The process performed by the receiver to recover the original signal in the presence of channel degradation and to transform the detected signal back to a digital signal. Notes: There are two common methods of detection. Coherent detection requires a reference waveform to be generated at the receiver that is matched in frequency and phase to the transmitted signal. When	Coherent detection Joint-detection/Multi-user-detection supported

		a phase reference can not be maintained, noncoherent detection is used. Most radio transmission technologies use coherent detection for both forward link and reverse link, which significantly increases the capacity for these systems and differentiates them from 2G systems. **Joint detection** is used to coherently detect the data in CDMA and TDMA time slots that are spread with a limited number of CDMA codes to cope with multipath propagation effects at the MS and BS and improve overall performance. **Multi-user detection** involves the joint detection of all users in a cell. This technique significantly helps in reducing intracell interference and thereby increases the capacity of the reverse link. The implementation of multiuser detection will have an impact on the base station receiver complexity and architecture.	
15	**Power control (up-link and down-link)**	The adjustment of the transmitted power in order to keep the received power from each station in a multiple-access communication system at the minimum power required to maintain a given QoS. Note: Such a strategy maximizes overall system capacity.	Closed loop on dedicated channels Open loop on random-access channel
16	**Variable data rate (up-link and down-link)**	A feature that adapts the instantaneous transmission rate on a specific traffic channel to the instantaneous amount of data to be transmitted in accordance with the demands of a data source or the propagation conditions. **Symmetric/asymmetric data rate** The capability of a system to operate with equal (symmetric) or different (asymmetric) data rate on the downlink and uplink in order to support symmetric or asymmetric uplink/downlink traffic. Note: The efficient support of asymmetric rate allows for optimal usage of the radio resources, resulting in higher overall system capacity when the users' traffic is mixed, i.e., both symmetric and asymmetric.	~~Supported~~ Different data rates supported with: - Variable spreading factor - Multi-code - Multi-slot (TDD only) - Code puncturing - Unequal repetition - DTX (DL only) - Rate can change on frame-by-frame basis - UL/DL data-rate asymmetry supported - Overall UL/DL asymmetry supported with TDD
17	**Diversity**	Diversity is the process by which several replicas of the same information-bearing signal are transmitted and received over multiple channels that exhibit independent fading. Note: There is a good likelihood that at least one or more of the received signals will not be in a fade at any given instance in time, thus providing adequate signal level to the receiver with reasonable	– ~~•~~ Time diversity – ~~•~~ Frequency diversity – ~~•~~ RAKE diversity – ~~•~~ Antenna diversity – ~~•~~ Transmit diversity, both open loop and closed loop,

		transmitted power. Diversity techniques seek to generate and exploit multiple branches over which the signal shows low fade correlation. To obtain the best diversity performance, the multiple access scheme, modulation, coding and antenna design must all be carefully chosen so as to provide a rich and reliable level of well-balanced, low correlation diversity branches in the propagation environment. Successful exploitation of diversity leads to: reduced power requirements increased coverage improved battery life improved voice quality and handover performance.	for FDD mode Selective transmit diversity or parallel transmit diversity for TDD mode
18	**Adaptive equalizer**	Time varying channel dispersion due to multipath propagation can cause inter-symbol interference, resulting in increased Bit Error Ratio (BER) or dropped calls on wireless communication systems. Active equalization is the process of reducing inter-symbol interference in a communication system by real-time adjustment of a filter that compensates for a time-varying multipath channel. Note: Adaptive equalization is essential for Time Division Multiple Access (TDMA) communication systems to meet the high data rate service requirements of IMT-2000, such as high spectral efficiency and reasonable costs for outdoor macrocellular environments. Adaptive equalization can also be utilized to increase TDMA system capacity. The effectiveness of adaptive equalization depends on the time-rate of change of the channel characteristics in comparison to the signal characteristics.	Not needed
19	**Dynamic Channel Allocation**	DCA is the assignment of channels in real-time, in accordance with observed traffic/interference conditions, as opposed to a prearranged channel assignment. DCA avoids planning of the radio channels and is required for uncoordinated systems sharing the same frequency band.	FDD: ~~Not needed~~Supported (Dynamic assignment to carriers) TDD: ~~Needed~~Supported (Dynamic assignment to carriers/time-slots)
20	**Duplexing Scheme**	The duplexing scheme is the method by which the transmitter and the receiver share the limited sources, such as time and frequency. This can be achieved through the use of frequency (Frequency Division Duplexing – FDD) and time (Time Division Duplexing – TDD).	FDD and TDD

21	**Multicarrier**	Muticarrier is a method to allow one transceiver to receive or transmit several carriers simultaneously. Note: Muticarrier can give flexibility of system planning and give backward compatibility, it also can help to easily use many new technologies.	Multi-carrier is not used